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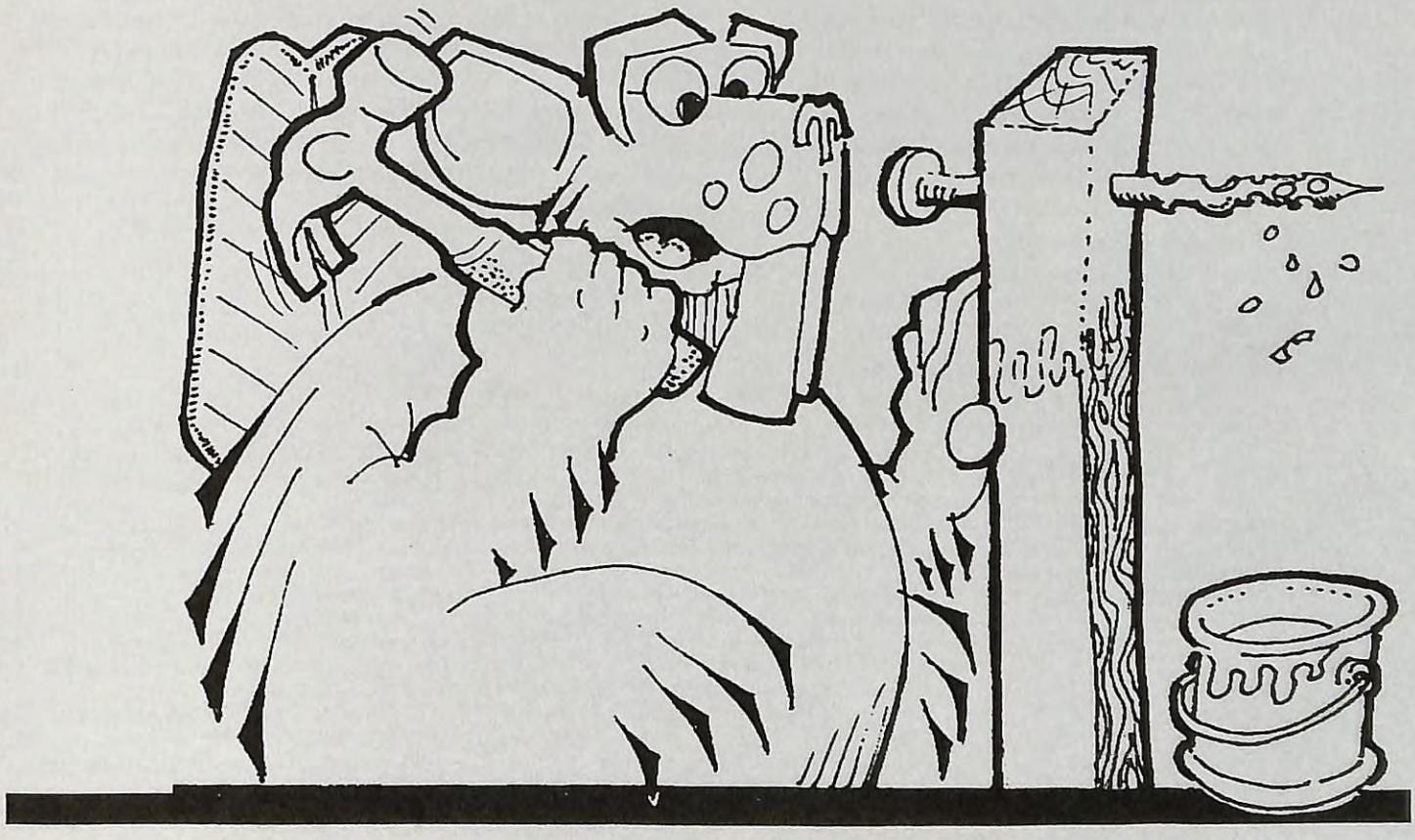
Inside

Using the Correct Fasteners for Treated Wood 3
CCA Pressure-Treated Wood 5
You asked us:
about thermal mass for solar storage 6
You asked us: about foundation design details 7
Letter to the Editor 7
Air Tightness of Houses 8
R-2000 Builder Licensing 8
Fireplace Efficiency 9
The Permeability of Oriented Strand Board 11
Safe Housing on Lightly Contaminated Lands 12
Moisture Management in Exterior Walls:
Case Studies 13
Insulated Rim Joists 15
Energy Answers 16
Technical Research Committee News 17
Workplace Safety Inspections, Residential Ventilation and Heating Systems, Objective-Based Codes
Construction Performance Guidelines 18

Fasteners for Treated Wood



From the Editor

The issue of safety on construction sites has recently received a lot of attention as workplace safety agencies have stepped up enforcement of safety regulations. There's been much gnashing of teeth and harrumphing about this issue. Comments are being made that the residential construction industry is being unfairly targeted; that unrealistic expectations are being made; that it will be impossible to build anything with the new rules; and that it will make housing unaffordable.

One often heard argument is that statistics for workplace accidents in the construction industry are faulty, since they often lump residential, commercial and industrial construction together. Maybe we don't have enough statistics broken down on sectoral lines, but implicit in this argument is the idea that costly accidents don't happen in the residential sector as often, and when they do happen they are less costly.

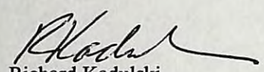
Such ideas are very disturbing. We cannot pretend that workplace safety is an issue we do not need to be concerned about. All construction workplaces have their problems. Injuries do happen on residential sites: People fall off roofs or high framing, things fall down and hit someone below, people get in the way of equipment. It doesn't matter whether the distance is 12 or 14 feet on a wood frame structure, a 12-storey concrete structure or a steel bridge. It doesn't matter if it is power saw or an old fashioned saw. The damage will be done. A broken leg is a broken leg no matter where or how it happened. A severed finger is a severed finger, no matter where it happened. Time lost, trauma and rehabilitation costs are the same. Sadly, on occasion (but fortunately not too often) fatalities do occur.

The questions we should be asking are: Are we being proactive enough in safety issues? Are we training everyone on site? Are we working safe? Or do we take too many chances? I've been on many job sites and am often surprised at what I see. Sometimes, I am torn between professional responsibility and common sense. At what point should I report a job site for unsafe work practices?

We need to do more to have safe working practices. Yet job site safety is seldom discussed. Yes, improvements have been made, yet how many people do we see on the roof without fall protection? How many sites are littered with debris, which are accidents waiting to happen? How many workers are wearing safety gear on the site when it is appropriate to do so? How many people on site understand how to properly use the tools they are working with?

Perhaps it is the manic drive to get more for less that pushes to reduce first costs. Some of the first things to get cut are the "soft costs" like safety training. How many young people who are hired to do so many of the menial labouring jobs on a site (actually their entry point into the industry), are given safety training and instruction when they are hired and given a task to do? Are they instructed on proper safety gear? Are they given the opportunity to learn to work safely? Are they being reprimanded when they take unsafe shortcuts, or do we just turn a blind eye, and applaud their initiative to be "productive" when they take inappropriate chances?

The absolute last argument that should be used is the cost thing. Safety is not a luxury, or do we value life so little that we don't care about those that are injured on a worksite? The life of a worker is not worth the few dollars we might save in an unsafe work environment. Nor can we afford the cost of rehabilitation and compensation of those needlessly injured at work. If we can't afford to do it right, perhaps we shouldn't be doing it at all!



Richard Kadulski,
Editor

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Using the Correct Fasteners for Treated Wood

Pressure-treated wood is widely used in residential construction. Wood treatment chemicals can react with metals, so it is important to use the right type of fastener with treated wood. Treated wood should be used only when such protection is important, as in areas where the wood is subject to decay or insect attack or is in contact with damp soil or water.

Chromated copper arsenate (CCA) has until recently been the most common wood preservative. As of January 2004, the manufacture of pressure-treated (CCA) wood for residential use ended in the United States and Canada. CCA will continue to be used to treat wood for use in industrial, commercial, and agricultural applications. Alkaline copper quaternary (ACQ) and copper azole (CA) are now replacing CCA in products destined for residential applications. This will require review of the fasteners used with them.

Recommendations on fasteners to use with specific types of treated wood have been made by the treated wood industry, the chemical industry, and the connector and fasteners industries. More testing is under way. However, in general, hot-dipped galvanized or stainless steel fasteners are recommended for use with treated wood. Aluminum is not recommended. Electroplated galvanized fasteners are also not recommended.

If hot-dipped galvanized fasteners and connectors are to be used, special attention must be paid to the level of galvanization. Current recommendations are that heavier galvanization is required for fasteners and connectors that are in contact with the new treatments than was the case for CCA. G60 galvanized fasteners and connectors are used with CCA treated wood. For ACQ or CA treated wood, hot-dipped galvanized fasteners must meet the ASTM A153 standard. Hot-dipped galvanized connectors and sheet products used with ACQ or CA treated wood should have a coating designation G185 as per ASTM A653.

Stainless steel fasteners and connectors are required for Permanent Wood Foundations below grade and are recommended for use with treated wood in other exterior applications. Type 304 and 316 are the recommended grades to use.

Electroplated galvanized fastener and metal products are not accepted for use in exterior applications, regardless of the type of wood used.

Copper Azole (CA) Treated Wood

The primary active ingredient in copper azole is copper, which has long been established as an effective biocide in timber preservation. Tebuconazole acts as the co-biocide in the copper azole preservative, providing additional protection from fungi that copper alone would not control. Tebuconazole is commonly used for protection from fungi on food crops.

Copper azole preservative penetrates into and remains in pressure-treated wood for a long time. However, some preservative may migrate from the preserved wood into the surrounding soil over time, and there may be incidental contact with skin during construction or use.

For best results, hot-dipped galvanized or stainless steel fasteners and fittings are recommended. Direct contact of copper azole treated wood with aluminum should be avoided.

Copper-azole-treated lumber can be painted or stained with any high quality oil or latex-based paint or stain. Water repellent coatings can be applied to improve weathering performance. It is important to ensure that the wood is dry and free from surface deposits prior to applying any film-forming coating. Always use products in accordance with manufacturers' instructions.

Residential users may dispose of treated wood scraps and cut-offs by ordinary trash collection or burial. Commercial and industrial users of treated wood should dispose of copper-azole-treated wood scraps and cut-offs in accordance with local, provincial and federal regulations.

CA pressure-treated wood may be used inside residences as long as all sawdust and construction debris are cleaned up and disposed of after construction.

Alkaline Copper Quaternary (ACQ)

The active ingredient in ACQ is copper, which has long been established as an effective biocide in timber preservation. Quat acts as the co-biocide in the ACQ preservative, providing additional protection from fungi and insect attack that copper alone would not control. Quats are commonly used in household and industrial disinfectants and cleaners and are biodegradable in soil. Copper and quat solutions similar to ACQ are used for the control of fungi and bacteria in swimming pools and spas.

ACQ preservatives penetrate into and remain in pressure-treated wood for a long time. However, some preservative may migrate from the preserved wood into surrounding soil over time and there may be incidental contact with skin during construction or use.

For best results, hot-dipped galvanized or stainless steel fasteners and fittings are recommended. Direct contact of ACQ treated wood with aluminum should be avoided.

ACQ-treated lumber can be painted or stained with any high quality oil or latex-based paint or stain. Water repellent coatings can be applied to improve the weathering performance. It is important to ensure the wood is dry and free from surface deposits prior to applying any coating. Always use products in accordance with manufacturers' instructions.

Residential users may dispose of treated wood scraps and cut offs by ordinary trash collection or burial. Commercial and industrial users of treated wood should dispose of ACQ-treated wood scraps and cut-offs in accordance with local, provincial and federal regulations.

ACQ-treated with wood may be used inside residences as long as all sawdust and construction debris are cleaned up and disposed of after construction. ☼

Handling of Treated Wood

Follow safe practices when working with pressure-treated wood. Specific work practices may vary depending on the environment and safety requirements of individual jobs.

- ✔ Wear gloves and long sleeves when handling treated wood.
- ✔ Wear a dust mask when machining any wood to reduce the inhalation of wood dusts. Avoid frequent or prolonged inhalation of sawdust. Machining operations should be done outdoors whenever possible to avoid indoor accumulations of airborne sawdust.
- ✔ Wear appropriate eye protection to reduce the potential for eye injury from wood particles and flying debris during machining.
- ✔ Wash exposed areas thoroughly with mild soap and water after working with treated wood and before eating, drinking, or smoking.
- ✔ If preservative or sawdust accumulates on clothes, launder before reuse. Wash work clothes separately from other household clothing.
- ✔ After construction, all cut ends, sawdust and construction debris should be cleaned up and disposed of in accordance with local regulations.
- ✔ All cuts and holes that expose untreated wood should be liberally brush-coated with an end cut preservative before wood is installed.
- ✘ Do not dispose of treated wood remnants or sawdust in compost heaps, wood chips or mulch as chemicals from the preservative may enter the food chain.
- ✘ Never burn treated wood. Preserved wood should not be burned in open fires or in stoves or fireplaces.
- ✘ Do not use treated wood in places where any preservative from the lumber may become a component of food or animal feed. Examples of such sites are structures or containers for storing silage or food.
- ✘ Do not use treated wood where it may come in direct or indirect contact with public drinking water, except for uses involving incidental contact such as docks and bridges.
- ✘ Do not use CCA-treated wood where direct food contact is possible (for example, cutting boards, counter tops, beehives).
- ✘ Do not use treated wood for mulch.

CCA Pressure-Treated Wood

Treatment with CCA extends the life of wood, thus reducing demand on forest resources. Arsenic, a time-honoured poison, kills wood-eating insects. Copper kills fungus. In 1933, an Indian engineer discovered that arsenic and copper chemicals injected into wood prevented timber beams from rotting. Chromium added to the formula bound the two toxic metals to the wood fibres. This led to the patenting of copper chromium arsenate (CCA).

Initially CCA pressure-treated wood was used for timber in industrial applications, such as for roofs, in underground tunnels and mines. It quickly attracted attention in the United States, where a patent was granted in 1938. Researchers in Mississippi found that wooden stakes treated with CCA put into fields that swarmed with termites were still standing months later. In 1950, Bell Telephone began using CCA-treated wood for telephone poles.

For years CCA-treated wood remained a specialty product largely used in industrial applications. It was not until the 1970s, when the availability of naturally rot resistant lumber diminished, that pressure-treated cheaper species started to be widely used. At that time there was also more use of treated wood because of design and lifestyle changes. Outdoor living became fashionable, and landscaping incorporated pressure-treated wood decks and outdoor furnishings for tables, gazebos, and landscaping timbers became common.

Concerns about the use of pressure-treated wood emerged as treated wood began to be widely used in residential applications. Recently it has been discovered that chromium is not as effective a binding agent as was once thought. Studies have found that the arsenic in pressure-treated wood can rub off on the hands of those who touch it. In the presence of rain or running water, the arsenic and copper can leach out to contaminate the soil.

Arsenic and its inorganic compounds are known to have caused cancer in humans after long-term exposure to high levels. Arsenic can be found naturally in soil, food and water, but at extremely low background levels. In 1990, the US Consumer Product Safety Commission found that contact with pressure-treated wood playground equipment increases a child's exposure to arsenic. The US National Research Council found that arsenic exposure through drinking water was linked to lung and bladder cancers and could exert its carcinogenic powers at much lower levels of exposure than previously believed. Children, whose livers metabolize arsenic more slowly, are at an increased risk of developing lung and bladder cancer.

Although not necessary, measures can be taken to reduce the potential for exposure from existing structures made of CCA-treated wood. While available data are very limited, some studies suggest that applying penetrating coatings such as oil-based, semi-transparent stains on a regular basis (e.g., once per year or every other year depending upon wear and weathering) may reduce the migration of wood preservative chemicals from CCA-treated wood.

In Canada, over the past few years the wood treatment industry has been working with Environment Canada, Health Canada and the Pest Management Review Agency to reduce the levels of arsenic in the environment. Producers obtained approval for alternative wood preservatives in 2002, and have agreed to move away from the use of CCA-treated lumber for the residential market. This mirrors the move in the United States.

As of December 31, 2003, wood treaters are no longer using CCA-treated wood intended for non-industrial uses such as play structures, decks, picnic tables, landscaping timbers, residential fencing, patios, walkways and boardwalks. This voluntary move is designed to reduce the amount of arsenic released into the environment. CCA will continue to be used for industrial applications such as highway construction, utility poles and pilings. ☼

Treated-Wood Information

To ensure proper handling of treated wood during construction, the wood treatment industry has initiated an information program, which includes labelling and other communication vehicles. A large amount of information is available from:

The Canadian Institute of Treated Wood
Tel. (613) 737-4337 Fax (613) 247-0540
www.citw.org
www.preservedwood.com
www.ccasafetyinfo.ca

You asked us: about thermal mass for solar storage

I am renovating a small 750 sq. ft. structure in the Okanagan valley to make it a year-round residence. The building has a southeast facing wall and I want to take advantage of the passive solar potential. The existing floor is an uninsulated slab-on-grade and I am looking for a flooring material that is easier on the feet than concrete and can act as a thermal mass. Do you have any suggestions? Would a hardwood floor have much ability to store heat? Are there resilient materials that provide a good thermal mass and are environmentally benign?

Unfortunately, there are no soft organic materials that have thermal storage potential; nor is wood able to store heat.

You mentioned that the slab is uninsulated. It is important to remember that, without insulation, the thermal storage capacity of any mass will be marginal at best. Remember that heat always flows from a warmer to a colder area, so as you heat the floor, it will merely travel down into the ground which is always colder. That is why insulation under slabs is so important. One reason why many people feel the concrete slab is hard on the feet is because of the heat loss away from the body and into the cold slab, which in turn is losing heat to the colder soil underneath. This is especially noticeable in homes today because of the tendency for us to walk around the house in bare feet.

There is a commonly held myth that the ground is an insulator. I am astounded by the number of people, even building professionals who should know better, who question the need for insulating the concrete floor slab in living spaces. Any concrete slab-on-grade in a living area should always be insulated, whether it is a basement floor, a walkout basement floor or a slab-on-grade bungalow.

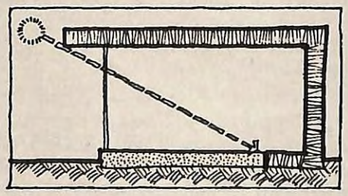
The soil is always cooler than indoor conditioned space, although the ground is not as cold as above grade. In winter, while the temperature can dip far below zero depending on local conditions, the deep ground temperatures (below local frost line) are always fairly constant and above freezing but cool. But any way you look at it, there is always a temperature difference between the indoor temperature and the soil. In southern Canada, typical average deep ground temperatures range from 5 to 11°C. That is why in the past, before refrigeration, in-ground root cellars were common.

How much insulation is placed under the slab is a matter of debate. In BC, the Building Code requires that heated slabs (i.e. those with radiant heating) must have a minimum of R12 under the entire slab. In my opinion, this is a minimum amount and should be used in all living spaces, regardless of whether or not the slab is heated. In northern and prairie regions with cooler soil temperatures and also in sites with wet soils, higher insulation levels may be appropriate because of the increased heat conductivity of the water in the soil.

For a renovation of an existing building, you should always consider insulating the slab if it is possible. Where height allows, this can be done by placing insulation over the existing slab, then adding a concrete topping and your finished flooring.

For increased comfort, you might consider using radiant heating with a tile floor. This provides a nice and comfortable solution.

If it is not possible to add a thermal mass layer, you should still consider insulating the slab before putting on a new finished floor, and plan on adding other features as a thermal mass to soak up the sun. These could be water containers or brick or stone feature walls. However, you need to remember that for thermal mass to be effective, it must be placed in a location where it can "see" the sun in order to soak up the heat. ☼



You asked us: about foundation design details

In the November 2003 Solplan Review (No. 113) item about rising damp in concrete foundations, you show details that seem to be going against what I had always learned as basic building science.

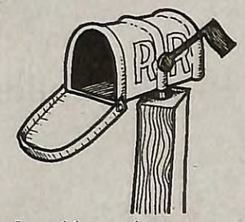
I understand that rising damp exists and that moisture has to be addressed. You suggest that one way to manage foundation moisture is to place the perimeter drains below the bottom of the foundation footings. However, I have been taught that if the drain tiles are put below the foundation footing it could easily lead to undermining the footings through erosion. We have always been told that the drain tiles have to be placed below the top of the footings and above the bottom of the footings - and you get whatever slope in the pipe you can within that distance.

A capillary break, such as a sheet of polyethylene between the footing and the concrete wall, should solve the problem of rising damp, although I realize not many people do this. It would completely stop your rising damp and not risk erosion below the footing when a water source happens to be coming from the under-the-house side of the footing. Is this a correct assumption, or are we solving one problem only to cause another?

Dropping the tile below the footing should not undermine the footing, since the drain is only a few inches lower than the bottom of the footing and will be surrounded by solid material with no fines (i.e. drain rock). The only time this may be a problem is if you actually have flowing water to wash the soil away, in which case there may be other problems that could affect the structure. The preferred way to place footings (and this is being done by some builders in the Vancouver area) is to place a bed of drain rock across the whole excavation, then place the structure on top - in effect, the whole building sits on a crushed rock bed. In this configuration, the drain tile is also below the footing. This is a standard practice used with wood foundations.

The layer of drain rock provides a capillary break between the structure and ground moisture, and also can act as a buffer in the event of major water loading that can occur if there is a sudden torrential downpour that overwhelms stormwater systems, as happens from time to time with summer thunderstorms.

Yes, one way to create a capillary break is to place an impermeable membrane on top of the footing before the concrete wall is poured. However, the reality is that often in low rise construction the wall and footing are poured as a monolithic pour, so there is no opportunity to place a break. ☼



Letter to the Editor

Re: Energy Conservation Information Gap

In terms of energy efficiency, Canadian homes are generally thought to be on the leading edge compared to the rest of the world. While this is true, when we look at components such as heat recovery ventilators (HRVs), windows and modelling software, there remains a huge and serious gap between homes built to the National Building Code (which is a minimum standard) and those built to the R2000 or similar standards.

Right now adding energy efficient options is voluntary. The case for adding them, while compelling, is not as well known as it should be. We are given, often without asking, the fuel consumption of new cars and the cost of loans. Appliances have a sticker that allows comparisons based on energy consumption. Yet the cost to heat our new home remains clouded in mystery until the bill arrives and the time to take effective and relatively inexpensive measures has past. By adding an Energuide label to all new homes, the Federal Government hopes to make consumers aware of the efficiency gap and potential improvements.

Consumers should be asking designers and builders for proper and full disclosure of estimated energy use in the home in time to do something about it. The technology to produce these estimates has been developed in Canada for the Canadian building system and is, indeed, a world leader. Why consumers and consumer advocates are not demanding this information is another mystery. Perhaps we need to make a greater effort to let them know this information is available.

Rod Parsons
St. John's, NL

Air Tightness of Houses

Airtightness is an important element of a houses's energy performance. Airtight building envelopes are important in reducing moisture problems as a result of air leakage, as well as contributing to a home's comfort and reducing energy consumption.

Many people mistakenly attribute indoor air quality problems to the increased air sealing that is done today. It is important to recognize that a house is a system, which is why mechanical ventilation and combustion appliances in a house must be carefully considered at the same time as the house is made more airtight.

Testing a houses's airtightness is part of the testing procedure for the Energuide for Houses label. Since more than 80,000 houses across Canada have now been evaluated, we have a good snapshot of the airtightness of Canadian homes. It is interesting to note that the average tightness in new construction has been changing over the years. Although there are differences in the regions across the country, there is a definite trend to more airtight construction, whether done deliberately or not. Many of the changes in airtightness are the result of new construction materials, techniques, and homeowner expectations for comfort.

The table shows the typical airtightness of houses across Canada, and how it has changed over the years. The data is from the Energuide for Houses database. The air tightness numbers for houses built after the year 2000 are based on a very small sample, so should be considered as approximate, but they do present a picture where we are at today, and why we must pay more attention to mechanical ventilation in new construction. ☼

Typical Air Changesper Hour at 50 Pascals

Region	*Pre 1920*	*1921-1945*	*1946-1960*	*1961-1970*	*1971-1980*	*1981-1990*	*1991-1999*	*Post 2000*
Atlantic	13	9.6	7.7	6.4	5.8	5.1	3.6	3.5
Quebec	9.8	7.7	6.9	5.7	4.9	4.8	4.1	4.03
Ontario	12.1	10.4	7.7	6.4	6.2	4.9	4.3	3.72
Prairies	9.3	7.4	5.2	4.2	4.8	4.2	3.4	2.6
BC	12	10.7	10.7	8.4	7.9	7.1	4.7	4.5

R-2000 Builder Licensing

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000 www.R-2000.ca

The R-2000 program maintains a national database of builders and service providers. In 2003, Natural Resources Canada began a process to update all licence agreements related to the R-2000 Trademarks to meet current requirements of the Government of Canada's Intellectual Property Policy, and issued new licences to active R-2000 builders and service providers.

As of April 1, 2004, builders and service providers who are not licensed by NRCan under the auspices of the R-2000 Standard will no longer be able to market themselves as R-2000 builders or service providers. As noted in a letter sent to those concerned, "'This is . . . only fair to those builders and service providers who recognize the value of maintaining their licences and certifying the homes they build."

NRCan will no longer certify homes that are not currently registered in the R-2000 database. All homes that are already registered in NRCan's R-2000 database will continue to be identified as such until they are either certified R-2000 or they lapse in time in accordance with the R-2000 Administrative Procedures. In order to be recognized as licensed under the auspices of the R-2000 Standard, an individual or organization must meet three requirements: maintain the appropriate R-2000 training over a

Continued on page 9

Fireplace Efficiency

The fireplace is a central feature in North American homes. Traditional wood burning fireplaces are extremely inefficient. That roaring fire provides heat only to that one room when the fire is burning, and for the rest of the time when there is no fire, the chimney flue acts as an open exhaust duct allowing warm house air to escape. If the house is airtight and there are large exhaust fans, the flue could also be a source of contaminated make-up air.

Depending on the design of the fireplace and whether it is located on an outside wall or in the centre of the house, it may suck more heat out of a house than it supplies. The efficiency of the traditional wood burning fireplace is hard to establish as it depends on many factors beyond the design, including the fuel type and how the occupant manages the fire; but the estimated efficiencies range between -10% and +10%. In most instances, on a cold winter day the conventional fireplace will actually result in an increase in fuel consumption for heating.

Gas-fired fireplaces have virtually eliminated wood-burning fireplaces in new construction and can be used in multi-family dwellings. They offer all the aesthetic features of the traditional fireplace, but are clean and easy to use with significantly fewer emissions than wood-burning appliances. Propane versions are available for areas without natural gas service.

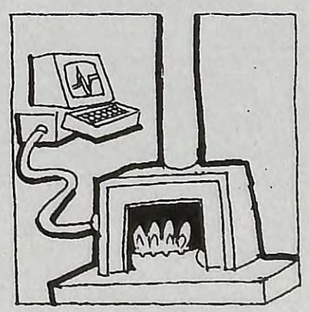
Gas fireplaces are sometimes used as a primary source of space heat, especially in multi-family apartments. For energy efficient homes, which can have design heating loads as small as 20,000 to 30,000 BTU/hour, some gas fireplaces could create overheating problems unless they are sized carefully. Some units have heat outputs as high as 68,000 BTU, although most are in the 17,500 to 37,000 BTU/hr range.

Are gas fireplaces really more efficient?

To encourage the use of higher efficiency equipment, NRCan has supported the industry in the development of the CSA P.4.1 Gas Fireplace Performance Standard. All gas-fired fireplaces imported into or sold in Canada must now be rated in accordance with this standard. The ratings are like those for furnaces and water heaters and must be provided on all product literature.

The performance ratings will also be published on the Office of Energy Efficiency Web site. The efficiency rating of the products for a number of manufacturers have been posted. All suppliers should be able to provide the data on request, if this does not yet appear on their sales literature.

The objective is to make it easier for consumers to make informed choices about hearth products by using a single test protocol. Unfortunately, that is still not easy to do. Many of the model numbers listed on the OEE Web site do not match the model numbers or names on manufacturer's literature. Product literature generally still provides information about everything but the unit's performance. Because manufacturers are also selling into the US, up to three numbers may appear on literature: the steady state maximum efficiency and the annual fuel utilization (AFUE), which are used in the US, and now the new Canadian P4.1 ratings. Since each measures energy use slightly differently, the results are different. The tendency



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three-year period; be involved in the certification process of a house certified R-2000 over a three-year period; and be in possession of a duly signed R-2000 licence agreement issued by NRCan.

Builders not currently licensed as an R-2000 builder, or whose licence has lapsed, can forward information for a new house to their delivery agent who will register the home in the R-2000 database once all the appropriate licensing criteria are met. A benefit of licensing is that the builder's contact information is placed on the R-2000 web site. With the increased profile that the R-2000 Standard is gaining through a variety of marketing efforts, listing on the web provides an effective marketing opportunity that pre-qualifies inquiries.

For information about the R-2000 Standard or the R-2000 builders' licence, contact your delivery agent or NRCan. ☼

Gas Fireplace Efficiency Ratings

Brand/Model	Ignition (Pilot)	Input rating (BTU)	Efficiency (%)
Continental BCDV40	Standing	30000	66.8
Continental BCDV33	Standing	16400	59.1
Continental BCDV38	Standing	26000	24.9
Earth Stove EUROPA	Standing	40000	62.2
Excalibur P95-NG	Standing	45000	67.3
Hampton H35-NG	Standing	36000	67.5
Hampton H15-NG	Standing	18000	60.3
Hearth & Home Technologies SAPPHIRE	Standing	30000	64.1
Hearth & Home Technologies DV250GARNET	Standing	17500	57.3
Heatilator CNXT90I	Intermittent	45000	77.0
Heatilator MAX60	Standing	40000	75.5
Heatilator ND3933I	Intermittent	22000	68.4
Heatilator AZTEC	Intermittent	23000	45.8
Heat-N-Glo 6000TRI	Standing	30000	67.8
Heat-N-Glo BE-36-C	Standing	18500	51.9
Heat-N-Glo BRAVO	Intermittent	23000	45.8
Krog Iversen SCAN1GAS	Standing	30000	65.0
Lennox Hearth L30 DVF-2	Standing	37000	64.8
Lennox Hearth MPDR-3328CNE	Intermittent	17500	53.4
Lennox Hearth MPDT-3328CNM	Standing	17500	43.2
Napoleon GDS50	Standing	44000	70.0
Napoleon GD33	Standing	22000	64.6
Napoleon GD34	Standing	24500	54.0
Napoleon BGD34	Standing	16400	53.6
Regency U39-NG	Standing	38000	71.6
Superior DR-600CEN	Intermittent	29000	60.1
Superior DR-600CMN	Standing	29000	56.9
Superior DR-400CEN	Intermittent	17500	52.8
Superior DT-400CMN	Standing	17500	46.5
UltraGlow G36D-NG	Standing	26000	60.3
UltraGlow G33R-NG	Standing	15000	59.8
Valor 530XAN	Standing	20500	69.0
Valor 535XAN	Standing	30000	63.6
Waterford E65-NG	Standing	38000	66.4
Waterford T25-NG	Standing	25000	63.9
Heat-N-Glo CRESCENT	Intermittent PV	29500	24.8
Napoleon BGNV42	Standing NV	28500	25.4
Regency C33-NG	Standing NV	33000	55.3

Standing = standing pilot light; Intermittent = electronic ignition
PV = power vented; NV = naturally vented All others are Direct Vented

A complete list of tested fitrplaces is published on the Natural Resources Canada Website: *http://oee.nrcan.gc.ca/equipment*

will be to focus on the most favourable number.

The steady state efficiency measures only what happens during the combustion process when the fire is at its optimum; the AFUE simulates more realistic seasonal operating conditions.

The P.4 test takes into account other factors including: seasonal operation; efficiency at low as well as high input; the size of the pilot, which is assumed to run when heat is not required and is therefore wasted energy; heat not recovered when the fireplace is cooling down after being turned off; outside infiltration air for combustion on B-vent units, which in theory must be heated. It also assumes that a fireplace is operating in cycles like a central furnace (i.e., on and off every 40 minutes). The numeric value of this rating will always be the lowest of the three, but it probably best approximates realistic performance.

A direct vent gas fireplace is the best option from both a safety and energy efficiency perspective. With its sealed firebox and an electronic ignition system, rather than a standing pilot light, it can be quite efficient and can provide significant useful heat to the house.

Many units have a variable setting control, which allows the user to adjust the temperature by regulating the rate of gas consumption. For maximum energy efficiency and comfort control, the model should have a wide turndown range – some units can be turned down only to 70 percent of full load, but others can go as low as 20 percent. Some models also have an automatic thermostat control, which will adjust the firing rate to keep the room at just the right temperature.

The table lists a representative sampling of efficiency ratings for gas fireplaces. It is interesting to note that there seems to be little consistency in energy efficiency based on either its size or whether it has a standing pilot light or electronic ignition.

Although most units are direct vented, a power vented or naturally vented units are also rated. For comparison, we've included a few of them at the end of the table. ☼

Wood Fired Appliances

Although gas fireplaces and stoves have virtually taken over the hearth product market in urban areas, burning wood is still an important option for home heating especially in rural areas. Major advances in the 1990s have made burning wood cleaner with less smoke and more heat extraction from the fuel. More efficient technologies include:

- ☞Pellet stoves that use compressed wood and other biomass wastes, capable of providing at least 24 hours of unattended, automated heating.
- ☞Free-standing wood stoves with catalytic burners that burn smoke before it leaves the appliance.
- ☞High-thermal-mass masonry heaters which take advantage of mass – in the form of bricks or stone – to absorb and later release the heat from the fire.
- ☞Central furnace/boiler usually in combination units with another fuel.
- ☞Performance standards that identify newer, cleaner-burning units are CSA-B415.1-M92 Performance Testing of Solid-Fuel-Burning Heating Appliances, or the US Environmental Protection Agency (EPA) wood-burning appliance standards (1990), 40 CFR Part 60. Any wood-burning appliance to be used in R-2000 homes must comply with either of these standards.

The Permeability of Oriented Strand Board

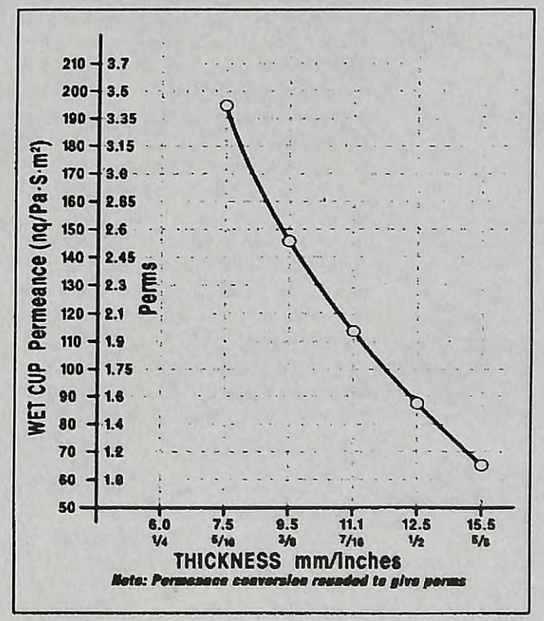
Permeability is the rate at which water vapour passes through a material. A question often asked is whether panel products used as sheathing on the exterior of the building act as a vapour barrier on the cold side of the building envelope.

To provide some answers, the Structural Board Association had Forintek Canada perform a series of "wet cup" tests on OSB and waferboard panels in accordance with ASTM test procedures. These are the tests used to determine the permeability of materials. Materials with a permeability of 1.0 perm or less (60ng/Pa.S. m²) are considered to act as vapour barriers, and materials with a permeability of 2.0 perms or more (118ng/Pa.S.m²) are considered to pass sufficient water vapour that a wall cavity will dry out when constructed with green lumber.

5/8" (15.5mm) OSB panels can be installed as a floor over unheated spaces without the need of a vapour barrier, while 7/16" (11.0mm) when installed as wall sheathing will allow a wall cavity containing saturated stud lumber and glass fibre insulation to reach an equilibrium moisture content below 19% in about 60 days.

So the answer to the question of whether OSB would act as a vapour depends on the thickness of the material. The graph plots the permeability for a range of OSB panel thicknesses. ☼

PLOT OF PERMEANCE vs. THICKNESS
OSB AND WAFERBOARD



Safe Housing on Lightly Contaminated Lands

Abandoned urban industrial lands are increasingly being redeveloped for housing. Many of these sites have some residual contamination on them. Developers and regulators recognize that there are risks due to contaminants in the soil, but are apt to see these risks as manageable and in line with other health or financial risks encountered in construction. Provincial authorities now allow site-specific risk assessments rather than depending solely on generic soil criteria. As a result, more developments are taking place on inner-city lands.

Developers, environmental consultants and regulatory bodies now often use site-specific risk assessments to determine the degree of risk to occupants due to unremoved contaminants. Risk assessments predict the potential exposure to contaminants that residents of the buildings will face, and the risks due to these exposures. The assessments can vary widely from one consultant to another.

CMHC has done research on remedial measures on contaminated sites for a number of years. Proof of a successful site design and remediation would include measurement of pollutant levels in the buildings after their completion, particularly if the monitoring period is long enough to catch seasonal variations. CMHC has investigated the success of remedial measures in previous studies. That survey work was retrospective, based on projects already complete, and the research suffered from a lack of data. However, none of the cases investigated included risk assessments with predicated pollutant levels.

A recent research project was designed to determine if potential risks to occupants from subsurface contaminants are being handled well in these developments. The consultant was asked to:

- Locate three developments where housing was being built on sites known to have had soil contamination, and where site specific risk assessment procedures were used to reduce soil cleanup;
- Negotiate with the developers, municipal and provincial regulatory agencies and homeowners so that predicted contaminant levels could be recorded, and obtain access to occupied residences;
- Measure contaminant levels in representative buildings; and
- Report on the results of this research to CMHC, the cooperating agencies, and the homeowners.

This study was designed to evaluate if the site-specific risk assessments and risk management process can provide adequate protection for occupants of residential buildings built on contaminated sites. Unfortunately, despite trying for more than four years, the consultant was only able to locate two sites with cooperative environmental contractors and willing building owners. One was a high-rise project on the waterfront in Vancouver. The second, in the small community of Wells BC, was a property where clean-up of arsenic laden mine tailings was done, but where no new houses had been built on the site.

Unfortunately, the project was not completed successfully because the project team was unable to interest developers or builders on brownfields to participate in the project. Most developments are never monitored for airborne contaminants after construction. Normally there is little indoor air quality monitoring done after construction, so builders and developers don't know if their houses are meeting the low pollutant concentrations suggested by the risk assessments.

It was impossible to convince the owners or developers of other projects being developed on lightly contaminated soil that the research project had value for them. This can be attributed to the risk to a developer should the study discover that the assessment was incorrect and that the residents were subject to significant contaminant exposures. It would take an unusually confident developer to take that liability risk just out of scientific interest. ☼

Safe Housing for on Lightly Contaminated Lands *by Golder Associates Ltd. Burnaby, BC for CMHC Research Division*

NRC·CNRC

Moisture Management in Exterior Walls: Case Studies

By M.Z. Rousseau

IRC recently completed its cross-Canada Building Science Insight Seminar Series (BSI) 2003 on moisture management in small buildings. Several private-sector building envelope specialists presented case studies concerning failures they had encountered related to poor control of rain penetration and condensation.

Out of the 15 case studies presented in the seminar series, a recurring problem appeared to be the balcony/exterior wall junction. Poorly designed or built junctions provided a path for rainwater infiltration into the wall, and contributed to the premature deterioration of wood-based elements of the wall. For several years, "leaky condos" on the West Coast made the news, and one could be led to believe that rain penetration failures are specific to wet climates. These case studies indicate, however, that such problems can also develop in drier regions, such as Ottawa.

Highlights of three of the case studies presented by Morrison Hershfield Limited at BSI 2003 are given below. These case studies emphasize the importance of adequate detailing at junctions between walls and penetrating elements such as balconies, windows and doors.

The building complexes were about 10 years old, multi-unit residential wood-frame construction, three to four storeys high. Some of the facades included balconies supported either by cantilevered joists or joists anchored to the wall at one end and supported by posts at the other end. The triggers of the investigation varied from case to case.

In one case, small amounts of rainwater tended to find their way into the units, wetting carpets and staining ceilings on an intermittent basis. In another building, the balcony had collapsed by about 50 mm when someone stepped on it. In the third building, an advanced state of deterioration of the structure was observed during renovations to replace a patio door. Interestingly, in all cases the exterior cladding was not showing any telltale signs of the deterioration going on within the wall. Building occupants had not complained of serious damage or problems. In other words, in ten years of service life, few minor symptoms on the interior and none on the exterior of the buildings had been apparent. There were no "red flags" to indicate a progressive state of deterioration of the structure.

When the envelope specialists removed the siding during their assessment of the repair work needed, they observed that the wood-based sheathing board, and in places the stud cavity materials, exhibited severe deterioration resulting in a major loss of structural capacity *(Fig. 1)*.

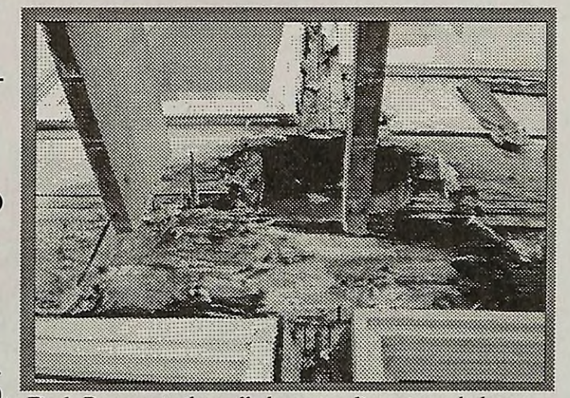


Fig 1. Damage to the wall elements adjacent to a balcony joist/wall connection

In certain cases, damage to wood materials adjacent to windows and doors (head and beneath sills) provided a clear trail of the water leakage and the location of its excessive accumulation *(Fig 2)*.

Lack of continuity of the second line of defence (i.e. the sheathing membrane – also called the water-resistive membrane – and the flashings) at the balcony level and at openings had allowed water infiltration on the interior side of the membrane, resulting in repetitive and excessive wetting of the moisture-sensitive materials of the walls. A portion of the water running down the face of the wood-based sheathing board was absorbed and remained there long enough to initiate rot. The spatial distribution of the damage on this element demonstrated clearly the water leakage path from floor to floor *(Fig 3)*.

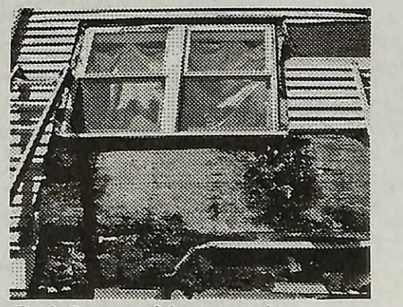


Fig 2. Pattern of damage to the sheathing board underneath the windows (Project B)

An examination of particular as-built construction details found a lack of continuity of the second line of defence as follows:

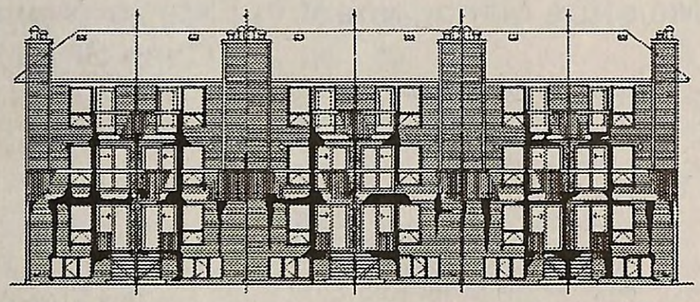


Fig 3. Pattern of distribution of the damage to the exterior sheathing board (Project A)

The framing and flooring of the balcony were completed before the sheathing membrane was installed. With this construction sequence, continuity of the sheathing membrane vis-à-vis the balcony floor was hardly possible due to lack of accessibility.

Again at the balcony level, no flashing or effective drainage plane was in place to direct the water that reached the outside face of the sheathing membrane back to the outside. In one case a metal flashing was in place but it was crushed against the wall by the ledger board *(Fig 4)*, eliminating the possibility for a free path for water evacuation at this strategic location.

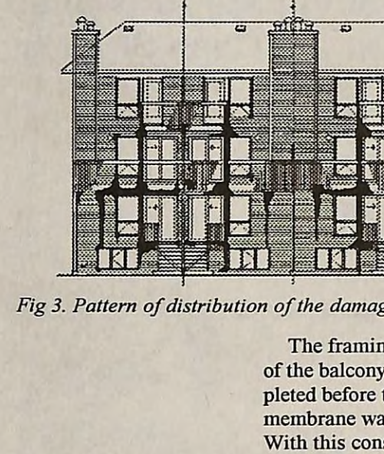
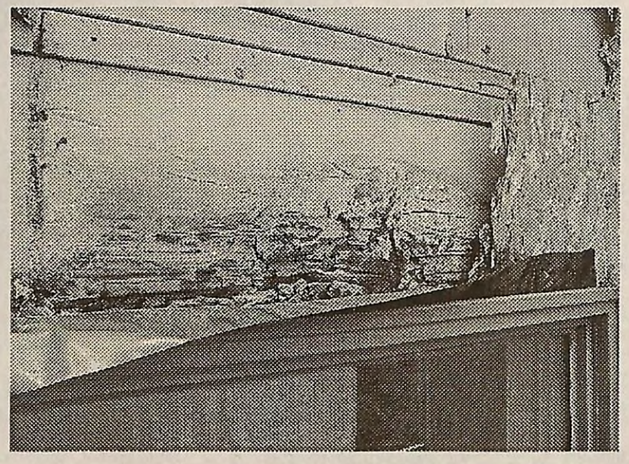


Figure 4. Flashing is in place, but is crushed between the wall and the ledger board, resulting in little potential for water drainage on its face (Project A)

The sheathing membrane and the flashing found at the wall/window junctions were installed in a reverse lap fashion, promoting the entrapment of water on the interior side of the sheathing membrane *(Fig 5)*.

Expensive repair work was necessary to replace damaged materials and to rebuild the wall assemblies so that the root of the problem would be eliminated. To start with, complete



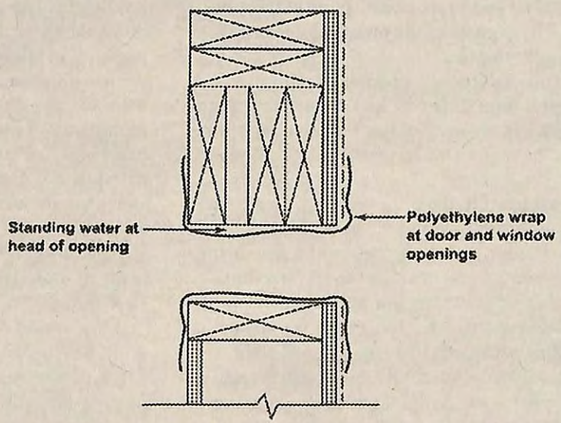


Figure 5. Example of reverse lap between membranes at the window head (Projects A and C)

detailed drawings of the junctions and interfaces were designed and presented to the contractor to ensure that the sequencing of work done by the trades would be compatible with the design intent.

Here are some elements for the rehabilitation of the facades of these buildings:

Ensure continuity of the second line of defence against water infiltration at the balcony level. This may be easier to accomplish when the balcony joists are fastened to the wall, as opposed to cantilevered joists penetrating all the way through the wall. This decision affects the sequence of construction, and needs to be acknowledged early on in the planning of the construction.

Provide a clear path for water drainage at the face of the sheathing membrane, using a clear air space and properly lapped flashings (so that the situation in Figure 4 is avoided).

Ensure that membranes and flashing are installed in a shingle-like fashion to avoid water entrapment inwards of the sheathing membrane.

Install a drip cap flashing at the window head, projecting laterally to protect the opening from excessive moisture loading, and with end dams to avoid redistribution of the water loads to the side of the opening.

Avoid extending a waterproof membrane to the underside of the head of a rough opening. This will reduce risks of creating a pocket for water entrapment as seen in Figure 5 (for example, during weather exposure during construction work).

Install a pan flashing over the rough sill of doors and windows. It is intended to collect any accidental water leakage and evacuate it back to the outside (with proper lapping).

Install eavestroughs and downspouts on sloped roofs to reduce the water loading on the balcony decks.☼

Madeleine Rousseau is a researcher in the Building Envelope and Structure Program of the National Research Council's Institute for Research in Construction. She was the technical leader of BSI 2003. This article is based on one of the seminar papers entitled "Field Experience with Moisture Management – Putting Principles into Practice." These case studies were part of contributions by Mr. Kevin Chouinard and Mr. William Brown of Morrison Hershfield Limited, guest speakers at BSI 2003.

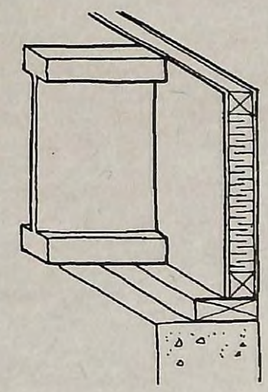
Insulated Rim Joists

We are using more engineered wood products today. Air sealing and insulating the rim joist with the I profile joists is a challenge, especially when exterior sheathing insulation is not being used. One option is to use spray foam insulation to air seal and insulate the rim joist. A new alternative is to use an insulated rim board.

Emercor Building Systems, a Calgary structural insulated panel manufacturer has created an insulated rim board. It is a mini stressed skin panel sized to match standard engineered wood joists. It can be installed around the floor system and replace the standard solid engineered wood rim board, thus eliminating the need to insulate and air seal between joists and in tight spots. Only simple caulking needs to be done.

Rim boards are available in 2¼" or 2½" thicknesses and depths from 9½" to 24". The exterior skins are OSB, and the core is filled with high density polyurethane insulation to provide an insulation value of R-14, with a continuous 2x wood strip at the top and bottom of each panel. The boards can carry a uniform compressive load in excess of 3500 pounds per lineal foot.

Information
Emercor Building Systems
Tel: 403-531-4346
Fax: 403-531-4372
www.emercor.com



Energy Answers

Rob Dumont

If you put in a high efficiency (90% seasonal efficiency) furnace, replacing a 60% efficient older furnace, will your space heating bills drop by 50%? The efficiency has increased by 50% (90/60 x 100% - 100%)?

Unfortunately the percentage reduction in space heating is not the same as the % improvement in efficiency. I won't go into the details of the math, but the actual reduction in space heating is only 33.3% for the above conditions and not 50%. Heating consumption is inversely proportional to the efficiency of the heating system.

Another way to look at this problem is to consider a house with a furnace efficiency of 50%. If the furnace efficiency were increased to 100%, the percentage improvement in efficiency would be 100%, but obviously the heating consumption would not drop by 100% (if it did, the house would have no space heating bill.) One has to be careful with mathematics!

For empirical proof of the above, I looked at an excellent survey done by Cam MacInnes[1] of Unies Engineering in Winnipeg. He looked at the actual percentage energy savings associated with converting houses with older conventional furnaces (atmospheric vented chimneys, pilot lights) to high efficiency furnaces. For the 49 houses surveyed, the measured space heating consumption corrected for heating degree days dropped by an average of 34% when a conventional furnace was replaced with a high efficiency furnace. That value of 34% agrees quite closely with the assumption that older furnaces have a seasonal efficiency of about 60%, and the new condensing furnaces have an efficiency of about 90%.

MacInnes also looked at the reduction in space heating when people used a mid-efficiency furnace to replace a conventional furnace. For those conditions, the reduction in space heating averaged about 19%. This is also relatively close in agreement with the math when you convert from a furnace with a seasonal efficiency of about 60% to a furnace with a seasonal efficiency of about 75%.

As space heating is the largest single load in almost all Canadian houses, the effect of improving the efficiency of all gas furnaces from about 60% seasonal efficiency to about 90% would be most impressive.

Given the large amount of energy used for space heating in this country, I would think that the time is now opportune for the Federal Government to mandate that all gas furnaces and boilers for new and retrofit applications have a minimum efficiency of 90%. The measure would have a double benefit to the country: greenhouse gases would be substantially reduced, and consumers would save energy dollars. The incremental cost at the wholesale level for condensing furnaces compared with mid-efficiency units is only several hundred dollars.

You have a relatively large solar heating system on your house. How much would it cost today to build such a system, and what sort of economic return are you getting on the system?

Our house has 168 square feet of solar panels, along with a 650 imperial gallon membrane-lined storage tank.

To replace the system, the current cost would be about $11,000 (excluding the space heating distribution system, which one would need anyway). I cross-checked this system cost with an experienced west-coast solar company.

Our solar system puts out about 30 gigajoules per year of useful space and domestic hot water, now that I have repaired a thermistor problem on the collector outlet. At current local electricity prices of about 10 cents per kilowatt-hour ($28 per gigajoule), the system saves about $740 a year, for an annual rate of return of about 6.7%. At current natural gas prices, the annual savings are considerably lower, at about $300 per year.

Compared with other safe investments, solar panels are not a bad investment, particularly if you are using electricity as the energy source of choice. ☼

[1]. *MacInnes, C. "**Experience with Higher Efficiency Gas Heating Systems in Manitoba: Implications for New Home and Replacement Applications**" Proceedings, 1989 Energy Efficient Buildings Association Annual Conference (Study sponsored by Manitoba Energy and Mines and Energy, Mines and Resources Canada [NRCan])*

Technical Research Committee News

Workplace Safety Inspections

The Ontario Ministry of Labour has stepped up enforcement of heath and safety practices on construction sites in the province. Fourteen new inspectors have been targeted for the residential construction sector alone. Builders, trades and suppliers are now watching workers' safety practices a little closer and developing policies to address areas of concern.

This is a topic that merits attention, not just for the sake of the health and safety of workers on site, but also because it has been established in law that there is a criminal responsibility for site safety issues. Disregard of workplace safety could have serious consequences for those in charge should there be any unfortunate accidents.

Residential Ventilation and Heating Systems

The EnerGuide for Houses program has evaluated about 10,000 homes in Saskatchewan. Evaluators are finding that about 5% to 10% of existing homes in the province have depressurization problems.

EnerGuide evaluators are recommending consumers change to high efficiency, sealed combustion furnaces in order to reduce energy use and to resolve depressurization problems. Unfortunately, mechanical contractors are telling homeowners that these types of products are not reliable and then proceed to sell consumers on mid-efficient furnaces. Mid-efficiency furnaces do not have a sealed combustion chamber, and may still be subject to backdrafting of combustion products.

A lack of understanding or a lack of confidence on the part of the mechanical trades may be causing them to downplay or discourage the use of the new equipment. This kind of attitude undermines all sectors of the industry, makes them look bad in the eyes of consumers, and creates uncertainty about who is correct.

It is important that all sectors of the housing industry maintain an open mind on new developments and support continued upgrading of products and training, so as not to undermine technical innovations.

Objective-Based Codes

The next edition of the National Building Code will be published in 2005. The new objective-based format will contain three divisions:

Division A. This will set out the conditions necessary to achieve compliance with the codes. It will list and describe the Objectives and Functional Statements applicable.

Objective Statements describe what the code aims to achieve, or the undesirable situations or consequences they seek to avoid. The objectives define the codes and provide the rationale behind the acceptable solutions. Every acceptable solution must be linked to at least one of the code's objectives. Sub-objectives and third-level objectives provide additional detail on the objectives.

Functional Statements translate objectives into operational terms. They describe the general conditions to be achieved. A functional statement is expressed in qualitative terms and describes the outcome required by the acceptable solutions, but not how to achieve that outcome.

Division B. This will set out the Acceptable Solutions including tables at the end of each part which list the functional statements and third-level objectives attributed to the provisions. This section will look very much like the current code book.

In the objective-based codes, the existing prescriptive and performance requirements of the 1995 codes become "acceptable solutions," a term that reflects their position as one of the many possible solutions under the objective-based code format. The acceptable solutions are a benchmark against which other means of meeting the codes' intents will be assessed or compared. Some of the technical requirements in the current code will be revised in the new edition.

Division C will contain the administrative provisions currently found in Parts 1 and 2. This material has been placed in a separate section because although the codes are being harmonized, provinces and territories have different administrative procedures following from the legislative context in which they adopt codes.

Portions of the code, such as detailed intent statements which describe what the acceptable

Canadian Home Builders' Association

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

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www.chba.ca

solutions aim to achieve, will be published only in the electronic version of the code, which will be on CD. This will make cross-referencing among different sections easy to do, although it will not be useful on a job site or away from the computer. However, all the essential material will be published in hardcopy.

Prototypes of the objective-based codes and related information prepared for the 2003 public consultation are still available for review on-line at: *www.nationalcodes.ca*

Training materials are being prepared. In 2005, code users and training providers will have access to training sessions and documentation that will describe the new format in greater detail, complete with examples and case studies applicable to the National Building Code, the National Fire Code and the National Plumbing Code. ☼

Construction Performance Guidelines

Builders and homeowners approach issues from different perspectives. This can be a problem if problems develop in a new house and the builder and homeowner have had difficulty in their relationship. Small issues left unresolved can fester and become magnified. In most cases, a builder and a homeowner can work together and resolve warranty problems in a friendly, professional way.

A document laying out performance expectations and standards, developed by a third party, can be a useful tool to help resolve problems. It can also be a useful reference for pre-delivery inspections. The Construction Performance Guidelines for the Ontario Home Building Industry published by the Ontario New Home Warranty Program is a document that provides information on the requirements of the warranties described in the Ontario New Home Warranties Plan.

The Guidelines were developed in consultation with various industry experts and following extensive research into the construction performance standards used by other North American home warranty programs. They are also intended to be a communication tool in the form of a handy reference guide for builders and homeowners.

The object of the Guidelines is not to set new standards, but to provide advance information as to how the Ontario New Home Warranty Program will render decisions regarding disputes between builders and homeowners about work or materials. They also help a builder and a homeowner understand how the warranty program evaluates warranty disputes.

Copies of the Guidelines are available on the warranty program's website: www.newhome.on.ca

The Guidelines can also help builders establish the construction standard that their trades must adhere to (e.g. builders can reference the Guidelines in their contracts with their trades), assess their own work and that of their trades, and answer queries from homeowners in a way that is seen to be objective.

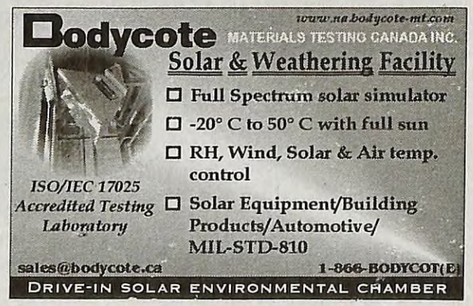
The Guidelines can help homeowners understand what is and is not covered under the statutory warranty in their home, and determine if items in their home have been installed and are working properly.

The Guidelines contain two types of standards for assessing the components of the home:

Standards Based on Measurement. These apply to anything that can be measured.

Standards Based on Construction Performance. These apply to items that cannot be measured.

Builders in other provinces will find this comprehensive document worth having. Experience has already shown the value of the document, as there have been some cases where homeowners dropped proposed action after reviewing the Guidelines. ☼



Solar Energy Society of Canada Annual Conference, August 21st-25th, 2004
The University of Waterloo will host the 29th Annual Conference of the Solar Energy Society of Canada.
Abstracts for technical papers to be presented at the conference are being invited on all aspects of solar energy and solar energy systems, including domestic hot water, solar heating and cooling, passive solar design, building design, fenestration, shading, energy efficiency and conservation, building materials, equipment and systems, commissioning, load management, case studies.

Abstracts due: May 7th, 2004
Details will be posted as they become available on the SESCI web site: *www.solarenergysociety.ca.*
SESCI2004 Organizing Committee
E-mail: *SESCI04@mecheng1.uwaterloo.ca*
SESCI-04 c/o Michael Collins
Department of Mechanical Engineering
University of Waterloo, 200 University Ave W
Waterloo, Ontario, Canada, N2L 3G1
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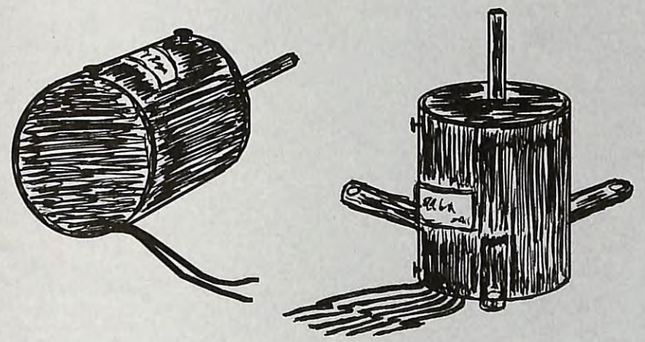

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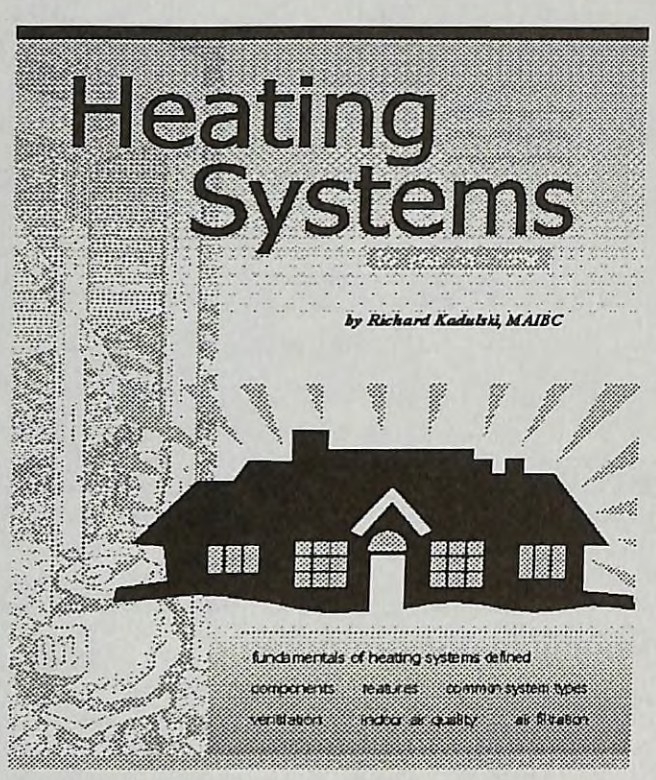
The following story has been making the rounds on the Internet. We couldn't resist reprinting it. Those who focus too much on payback should take heed.

Last year I replaced all the windows in my house with that expensive double-pane energy efficient kind. This week I got a call from the contractor complaining that his work had been completed a year ago and I had yet to pay for it.

Boy oh boy, did we go around! Just because I'm blonde doesn't mean I'm stupid. I proceeded to remind him of what his fast-talking sales guy had told me last year – that in one year the windows would pay for themselves. There was silence on the other end of the line, so I just hung up and I haven't heard back.



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